Chapter 24

Forensic Case Study

Child Abuse, the Skeletal Perspective

In forensic human osteology a key concern is often the identification of individuals based on the analysis of skeletal remains. The case study documented in Chapter 23 presented one example of how even the most fragmentary skeletal remains can be recovered, analyzed, and identified in a criminal investigation. Forensic work with skeletal remains often involves the documentation of events as well as identities. Within the last decade, for example, forensic osteologists have worked with authorities in Haiti, El Salvador, and Bosnia in efforts to reveal secrets of the very recent past. The current chapter presents a case study that illustrates the contribution that a careful analysis of skeletal remains can make in the realm of forensic science.

Child abuse is widespread in modern society. The magnitude of nonaccidental pediatric injuries is staggering. According to the Fourth National Incidence Study of Child Abuse and Neglect (NIS-4, https://www.nis4.org), there were more than 1.25 million cases of child abuse in the United States during the latest study year (2005–2006). Approximately 18% of these cases involved serious injuries resulting in more than 2400 nonaccidental deaths in infants and children. Before the 1990s, very little attention had been paid to the problems of identifying child abuse in the skeletal remains of children. Phil Walker and colleagues have changed this, with an important paper documenting their work on five case studies. One of these is detailed in the account below, an account that draws exclusively from Walker et al. (1997).

24.1 Child Abuse and the Skeleton

Forensic cases involving the skeletal remains of chronically abused children are common. When such a child is killed, the abusers may attempt to dispose of the body surreptitiously and claim that a kidnapping occurred. Under such circumstances, time may pass before the body is discovered, and a fragmentary, partial skeleton may be the only evidence remaining.

Such cases are very difficult for the forensic pathologist or radiologist who often lacks experience in dealing with defleshed skeletal remains. The patterns of scars, bruises, and soft tissue trauma seen by the medical examiner or forensic pathologist are no longer available as evidence under these conditions. Even the picture of the battered child syndrome seen radiographically is very different from the one studied by the forensic osteologist who is directly examining the bones themselves. In the case presented below, it was the expertise of the forensic osteologists

that led to the documentation of evidence not apparent to pathologists or radiologists — evidence crucial to the demonstration that child abuse had occurred.

24.2 A Missing Child Found

Police investigating a report of a boy who had been missing for five years discovered the partially skeletonized remains of a three-year-old child in the trunk of the family car. His parents first told law enforcement officials that the boy had died after slipping and hitting his head while taking a bath. Although at first they said that they had buried him, the discovery of his skeleton made it clear that instead they had carried the dead child in the trunk of their car for five years.

When the remains of the child were autopsied, the cause of death was not determined. The parents were charged with illegal disposal of the body. The remains were then sent to forensic osteologist Phil Walker of the University of California at Santa Barbara. An expert in both the forensic and bioarchaeological areas, Walker was well qualified to take a second look at the child's bones.

24.3 Analysis

Dental development was used to provide a precise age at death for the child using the techniques discussed in Chapter 18. Combined with long bone measurements, these data indicated an age of 3 to 4 years at death. More detailed histological work on the teeth, focusing on Retzius line and cross striation counts in histological sections of the child's teeth were consistent with an age of 3 years, 7 months at death. Furthermore, they indicated that the child had suffered disruption of dental development, the last occurring about two months before his death.

Although the remains of the child were left in the car trunk for five years, considerable soft tissue covered the bones. When the desiccated tissue was carefully cleaned away, a linear fracture was seen to cross the left occipital bone, extending from the foramen magnum to the lambdoid suture. A 3.5 cm^2 area of subperiosteal new bone formation was observed below the lambdoid suture, confined to the occipital, and extending to the fracture line (Figure 24.1).

Gross and histological analyses showed that the area of bone formation recorded at least two stages of healing. Most of the affected area lacked large porosities and was comparatively dense, reintegrating with the external vault table. To Walker's practiced eye, this indicated a month or more between the injury that produced the fracture and the death of the child. However, along the borders of the fracture, the well-healed bone was overlain by a second more recent episode of bone formation. Some of the fracture edge was starting to heal, and this newer, more porous bone would have taken more than a week to form.

Disruption of the healing process is commonly seen in child abuse cases. Multiple traumatic episodes lead to these osteological patterns. Parents involved in the chronic, repeated beating of their children usually avoid seeking medical treatment for the child for fear of detection of their abusive behavior. Untreated, the bone begins to heal, but the fracture can be reopened with further trauma.

Turning to the teeth, Walker noticed that an upper and a lower incisor had antemortem fractures. He could tell that they occurred before death because their occlusal surfaces were both worn. Such fractures, of course, could occur without any abusive parental behavior, but such injuries are found at high frequency among abused children, reinforcing the idea that this child had suffered repeated injury.

The rest of the skeleton held more evidence. The clavicle showed a healed fracture (Figure 24.2). The left radius and ulna showed areas of subperiosteal new bone formation. These lesions are thin layers of new bone that form beneath the periosteum in response to trauma and subpe-

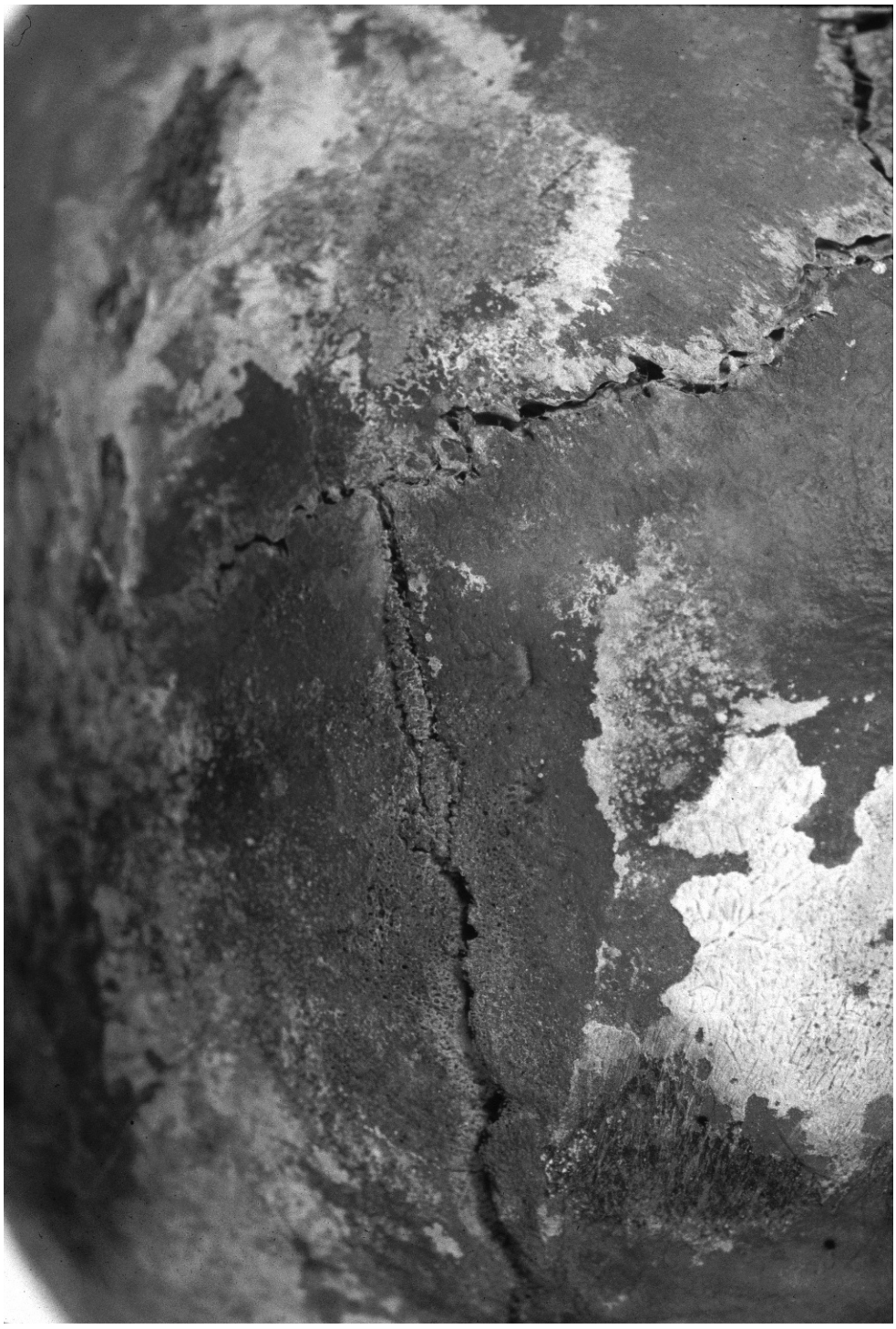

Figure 24.1 **Posteroinferior view of the cranium**. The lambdoid suture traverses the vault from left to right. The vertical fissure is a partially healed fracture of the occipital. Close examination of this fracture revealed at least two stages of healing, showing that the child incurred the injury at least a month before his death. Photo courtesy of Phil Walker.

Figure 24.2 **Healed fracture of the clavicle shaft** (*right*) **compared to the normal opposite side**. Photo courtesy of Phil Walker.

riosteal bleeding (Figure 24.3). They are often asymmetrically distributed and can result from beating or stripping of the periosteum from the bone when the limbs are forcefully traumatized. In this case, the forearm had been traumatized in this manner with an area of subperiosteal new bone on the distal half of the ulna that nearly encircled the shaft (Figure 24.4).

No other long bones showed evidence of subperiosteal formation. Walker's work on other child abuse cases has shown that asymmetrical distribution of such subperiosteal lesions in vulnerable areas where bones are subcutaneous is common. Here, the borders of the lesions on the radius and ulna were beginning to integrate into the adjacent cortical bone. This healing indicated that the trauma that had caused them occurred a month prior to the death of the child. None of these subperiosteal lesions was visible on the high-resolution radiographs. Indeed, they are usually less than a half of a millimeter thick, but readily apparent to the osteologist. Here, the bare-bones osteologist had the advantage of seeing what was invisible to the radiologist and forensic pathologist.

Radiographs of the child's long bones showed that there were many Harris lines (see Chapter 19). These were bilaterally symmetrical in the distal radius, with 15 lines in the distal 18 mm of the bone. Some Harris lines are normally present in children of this age, but fewer than 5% of children between the ages of 2.5 and 4 years have as many Harris lines as this child.

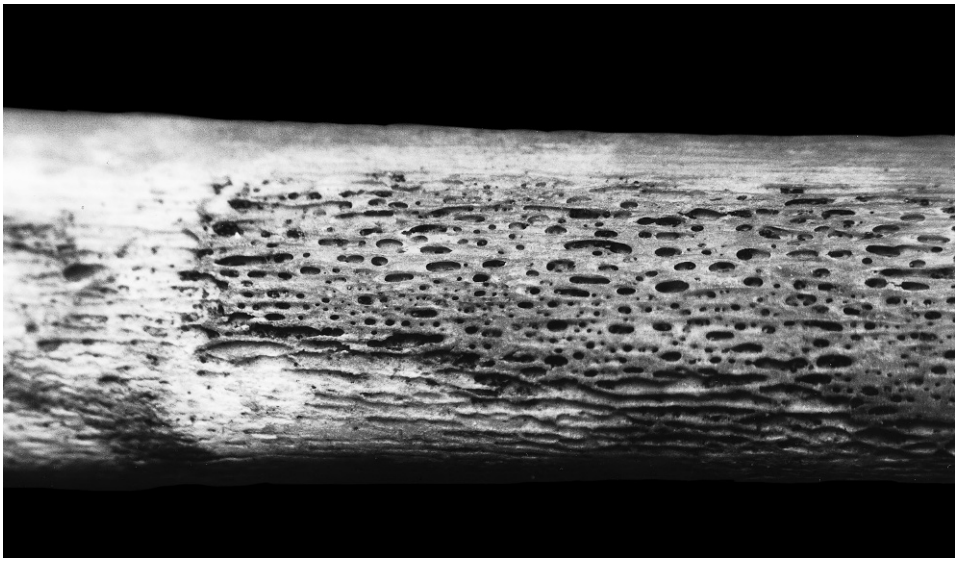

Figure 24.3 **From a similar case, an area of subperiosteal bone formation on the fibula**. This shows porosities and sharp margins indicative of recent healing. Some of the bone at the end of the lesion has been lost through postmortem flaking damage. Photo from Walker et al. (1997), courtesy of Phil Walker.

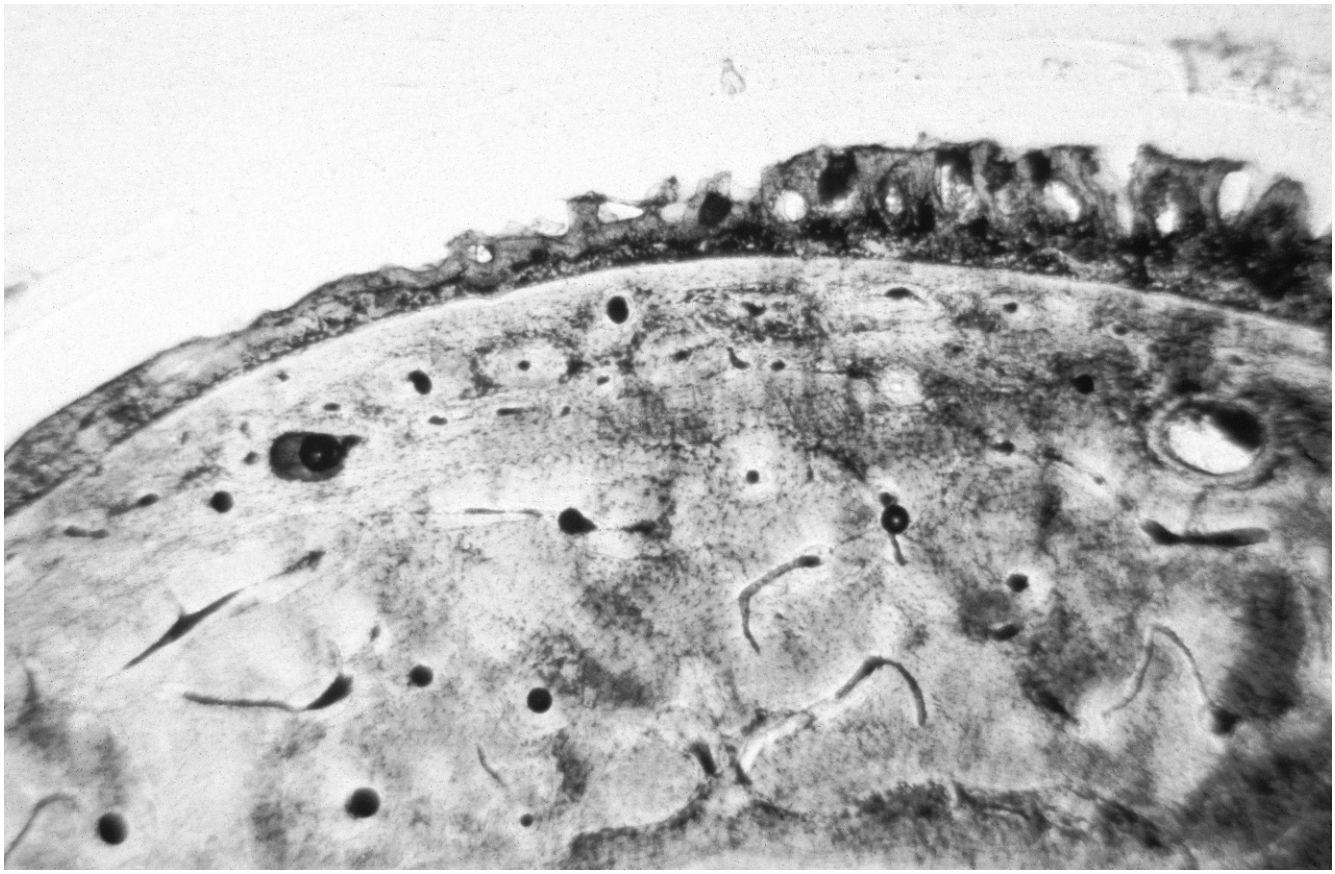

Figure 24.4 **Cross section of the traumatized radius, showing the histological appearance of subperiosteal new bone formation in response to trauma**. Normal, dense subperiosteal bone is seen at the margin of the lesion, with thickened, vascularized bone near the lesion's center. Photo from Walker et al. (1997), courtesy of Phil Walker.

24.4 The Result

Added up, the skeleton and teeth of the child whose remains had been recovered from the trunk of his parents' car showed that the months before the child's death had been punctuated with trauma. It was a pattern consistent with child abuse. Multiple injuries in different stages of healing are consistent with abuse. An accidental explanation for such injuries becomes increasingly unlikely as the number of traumatic episodes increases. The frequency of fractures produced by severe physical abuse decreases with advancing age, probably because smaller children are more easily held by their arms and legs and beaten, whereas such abuse is more difficult to inflict on older children because of their size and ability to resist. In this case, armed with the osteological evidence of severe physical abuse over a prolonged period, prosecutors charged the parents with second-degree murder, to which they eventually pled guilty.